**IMPLICATION ON POSSIBLE SUBMARIN BIOSIGNATURES AT CHAOTIC TERRAINS.** A. Kereszturi (Department of Physical Geolography, Eotvos Lorand University of Sciences, Pázmány sétány 1/C, Budapest, H-1088, Hungary, E-mail: krub@freemail.hu)).

**Introduction:** Observations and theories suggest Europa is interesting object for astobiology [1,2,3]. For future radar and cryobotic missions we have to know the best locations for analysis. Here we summarize aspects of some processes and structures in the icecrust interesting for astrobiology. We suggest the best locations are great chaotic terrains with signs of internal activity [4,5] which may hold information on the submarin geothermal centers too.

**Ice crust:** Based on the Galileo's images we estimated the relative height of "icebergs" inside at a 48x38 km part of the famous Conamara Chaos with errors of measurements below of 20%. We analysed the real shape of rafts by Airy isostasy taken the crust to be in mechanical, hydrostatical equilibrium and composed of ice with density of 0.9175 g/cm$^3$. On *Fig. 1.* the theoretical process of terrain breaking is visible: during the formation that blocks which were broken into pieces with greater height than width, rotate into more stable drifting position. Based on the size and shape distribution we can find the isometric shaped blocks which diameter is equal to the thickness were present before the terrain breaking.

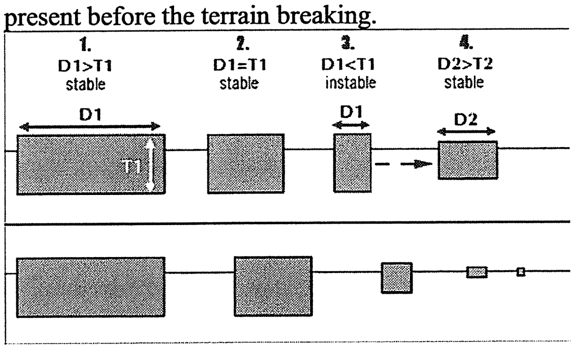


*Fig. 1. Height/thickness relation of fragments*

On *Fig. 2. A* the shadow based average relative heigth of certain blocks versus the blocks' maximal diameter is visible. The relative height distribution turns off around 75 m height and 2000 m diamater. Based on isostatic drifting, the absolute ice thickness of the original blocks were 2 km, of the matrix is about 0.5 km (*Fig. 2. B*) based on the "block rotation method". Before terrain breaking probably ice thinning took place until the onset of instable situation. This may be the reason that estimations from other authors prefer higher value near to 20 km [6].

**Processes during ice thinning:** Below the thinning ice we have decreasing hydrostatic pressure and gases become less soluble. Depending on the solubled gas composition and temperature of the warm plume, gases with high enough vapor pressure (like some carbohydrates) can "boil" and change into the form of gas bubbles. The best locations for bubble formation are along tectonic lineaments between rafts where water can get very near to the surface. Here we have not only concentration of gas bubbles but strong brine migration too. Based on the orientation of rafts' straight edges the breaking took place along previous linear weakening zones parallel to the lineaments of surrounding terrain (*Fig. 3*). Based on our calculation the low level matrix could be as thin as 500 m, at the faults even thinner with even lower overburden pressure. Gas bubbles freezed into the ice can give information on chemistry, possible nutrients at submarin volcanic centers.

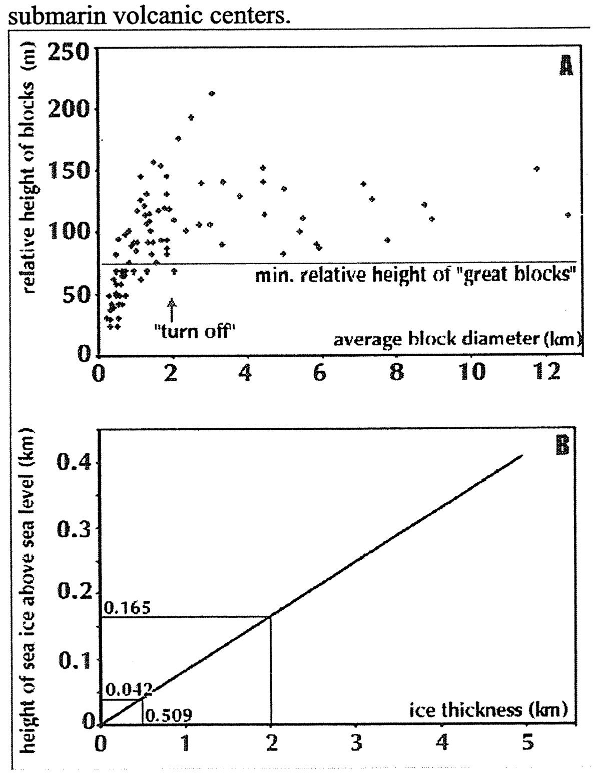


*Fig. 2. Blocks' diameter/height (A), and real thickness of blocks (2 km) and matrix (0.509 km) (B)*

**Processes during ice thickening:** Important precesses take place during thickening of the crust during the cease of submarin geothermal activity. The ice's thickening speed slows exponentially in an ideal case with the most imortant period at the beginning when obverburden ice is thin (hydrostatic pressure is low), and thermohalin water plume is still present. During the freezing of new ice we have the following possibilities: *1. Freezing of floating particles into ice* originated from submarin volcanic center. The settling speed of solid particles in water depends on the density difference and upward speed of water plumes and described by Stokes law. Under thermadynamic equilibrium at the base of the ice crust at chaotic terrain we have freezing and thawing together. Inside freezing parts solid particles can freeze into the ice. Based on estimations of [7] vertical water flow can be in the order of mm/s. With the average density of common weathered and hydrated silicates, spherical particles with diameter smaller than 1 mm can be carried to the top of the ocean with plumes [8]. During a cryobotic mission we can observe them if their settling velocity is lower than the cryobot's sinking speed. (In the case of faster setlling particles accumulate at the bottom tip of water filled cave around the cryobot.). *2. Chemical layering* because of vertical changes in the physical parameters. During the thickening of ice under growing hydrostatic pressure water can solve more material. As a result the thinner the ice is, the more material condense out from the solution. After the end of the refreeze we have decreasing ratio of solid condensates in downward direction and growing ratio of possible solubled and refreezed materials depening on phase changes inside the ice.

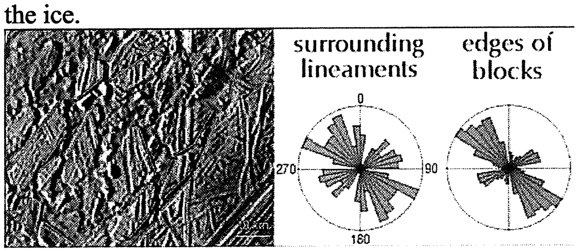


*Fig. 3. Distribution of orientation of blocks' edge and surrounding lineaments*

**Structures are probably present today:** Estimating the ratio of original and changed surface (with and without pre-breaking lineaments) we can have the recycled area and volume too. The former is nearly 50% at the analysed chaos and the later is 18000 km$^3$ if 2 km would have been the original thickness. In the case of 20 km of original thickness the same later is around of 160000-200000 km$^3$.

**Implication for future probes:** The best possible targets for in-situ analysis of the upper mentioned processes are: 1. young chaotic terrains (the older the terrain is the more extensive decomposition could took place by brine migration and other processes), 2. high ratio of matrix/original rafts (for much new and recycled refrozen material), 3. great size of chaotic terrains (higher level of geothermal activity rises more possible biosignatures and melts/refreezes more ice). Possible layering (chemical and physical) could be observed with sophisticated penetrating radar technology not only at fresh but at overprinted chaotic terrains. In the case of a cryobotic mission [9] without the ability of precise landing we have statistical chance to land and thaw through new and not old ice. But connecting our results with other estimations for original crustal thickness before terrain breaking, our probe have to meet with new ice deeper than 2 km. The best location would be in the low level matrix, we can land there with chance of 50% in the upper analysed case when the landing ellipse covers the central part of the chaos.

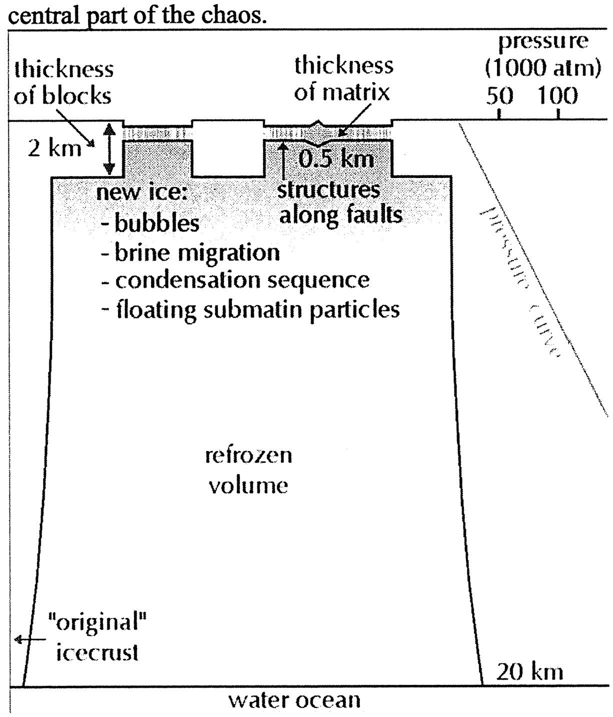


*Fig. 4.: Important structures in reforzen ice*

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